

Staff Report

**USE INFORMATION AND AIR MONITORING
RECOMMENDATIONS FOR THE PESTICIDE ACTIVE
INGREDIENTS SULFURYL FLUORIDE AND CHLOROPICRIN**

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ENVIRONMENTAL HAZARDS ASSESSMENT PROGRAM

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USE INFORMATION AND AIR MONITORING RECOMMENDATION FOR STRUCTURAL APPLICATIONS OF THE PESTICIDE ACTIVE INGREDIENTS SULFURYL FLUORIDE AND CHLOROPICRIN

A. BACKGROUND

This recommendation contains general information regarding the physical-chemical properties and the historical uses of sulfuryl fluoride and chloropicrin in structural fumigations. The Department of Pesticide Regulation (DPR) provides this information to assist the Air Resources Board (ARB) in their selection of appropriate locations for conducting pesticide air monitoring operations.

Sulfuryl Fluoride

Table 1 describes some of the physical-chemical properties of sulfuryl fluoride and figure 1 depicts its chemical structure.

Table 1 Some Physical-Chemical Properties of Sulfuryl Fluoride¹

Chemical name	Sulfuryl fluoride
Common name	Sulfuryl fluoride
Some tradenames [†]	Vikane
CAS number	2699-79-8
Molecular formula	F ₂ O ₂ S
Molecular weight	102.1
Form	Colorless, odorless gas
Solubility	Water: 0.75 g/L at 25 °C (EXTOXNET, 2001)
Vapor pressure	>760 mm Hg at 20 °C (Matheson Tri-Gas, 2001)
Soil adsorption Coefficient (K _{oc})	6.124 (Dow AgroSciences, 2000)

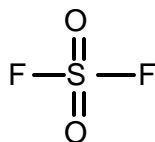
¹Data from DPR, 2001a.

Environmental effects of sulfuryl fluoride are expected to be negligible because it is only registered for applications indoors or in sealed structures (US EPA, 1993). Sulfuryl fluoride is a gas with low water solubility. It is sustainable to diffuse out of water into atmosphere, but not leach to contaminate groundwater (EXTOXNET, 2001). Under neutral conditions, sulfuryl fluoride hydrolyzes very slowly in water to chlorosulfonic acid and hydrogen fluoride, and

[†]Disclaimer: The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as either an actual or implied endorsement of such products.

ultimately to sulfuric acid and hydrogen fluoride. Hydrolysis under alkaline conditions occurs rapidly and forms fluorosulfonic acid and hydrofluoride (Tomlin, 1997; US EPA, 1993). Hydrolysis half-life is estimated to be 18 minutes to three days (Dow AgroSciences, 2000).

Figure 1 The Chemical Structure of Sulfuryl Fluoride



Sulfuryl Fluoride

Because use of sulfuryl fluoride is permitted only indoors, exposure to aquatic organisms and wildlife is unlikely, and data regarding these scenarios were not required for registration by the US EPA. Bioconcentration potential is low with a BCF < 100 (Dow AgroSciences, 2000). Exposure to birds is considered to be minimal. Inhalation LC₅₀ (4 hour) for male and female rats is 1,122 and 991 ppm, respectively.

Chloropicrin

Table 2 describes some of the physical-chemical properties of chloropicrin and figure 2 depicts its chemical structure.

Table 2 Some Physical-Chemical Properties of Chloropicrin¹

Chemical name	trichloronitromethane
Common name	Chloropicrin
Some tradenames	Chlor-O-Pic, Metapicrin, Chloropicrin-100
CAS number	76-06-2
Molecular formula	CCl ₃ NO ₂
Molecular weight	164.4
Form	Colorless liquid with a lachrymatory action (Tomlin, 1997).
Solubility	Water: 2.00 g/L at 25°C
Vapor pressure	23.8 mmHg at 25°C
Henry's Law Constant (K _H)	2.51 x 10 ⁻³ at 25°C
Soil adsorption Coefficient (K _d)	0.139- 0.311
Aerobic soil metabolism half-life	0.374- 5.13 days

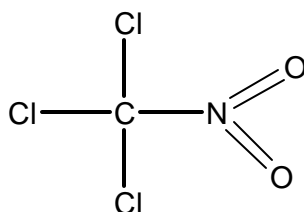
¹ Data from DPR, 2001a.

Chloropicrin is metabolized in soils by sequential reductive dechlorination. The end products are thought to be nitromethane and small amounts of carbon dioxide (Montgomery, 1997).

Chloropicrin moves rapidly in soils within twelve inches of injection, but may diffuse to maximum of four feet in sandy soil (EXTOXNET, 2001). Chloropicrin will not move rapidly

into aquatic environments since it is only slightly soluble in water. Chloropicrin has a higher density than water and will tend to sink to the bottom of surface water. Chloropicrin photodegrades in surface water to carbon dioxide, bicarbonate, chloride, nitrate, and nitrite with a half-life of 31.1 hours (EXTOXNET, 2001). Chloropicrin vapor is heavier than air and spreads along the ground (Howard, 1991). It efficiently photolyzes in atmosphere to phosgene, nitric oxide, chlorine, nitrogen dioxide, and dinitrogen tetroxide (EXTOXNET, 2001; Montgomery, 1997). When chloropicrin is heated to decomposition, toxic fumes of nitrogen oxides and chlorine are released (Montgomery, 1997).

Figure 2 The Chemical Structure of Chloropicrin



Chloropicrin

Chloropicrin is toxic to fish with an LC₅₀ (96 hours) of 0.0765 mg/L for rainbow trout and 0.105 mg/L for bluegill sunfish. It is nontoxic to bees when used as label recommended (Tomlin, 1997). Inhalation LC₅₀ (15 minutes) for rabbits is 150 ppm (Meister, 1996).

B. CHEMICAL USES

Sulfuryl Fluoride

As of December 2001, one product containing sulfuryl fluoride was registered for use in California. Sulfuryl fluoride is an inorganic gas fumigant used in structures, vehicles, furnishings (household effects) and wood products for control of existing infestations of drywood termites, wood infesting beetles, roaches, moths, and rodents. There are no registered uses of sulfuryl fluoride on food or feed crops.

For determination of fumigant rates, the Fumiguide calculator(s) is to be used with soil or slab temperature, exposure period, and fumigant loss rate measured as half-loss-time (HLT) according to the label and structural fumigation manual for Vikane® (99.8% active ingredient). The Fumiguide calculator determines the dosage for the drywood termite. Fumigation rates for other pests are listed on the label as multiple factors of the drywood termite dosage. No applications for fumigating insects are to occur if the temperature measured at the coolest part of the structure is below 40 °F. However, this restriction does not apply to fumigation of rodents. When fumigating a single unit of a multiple unit complex, all units must be vacated during fumigation and aeration. In preparation for fumigation, the label guides all persons, domestic animals, pets, fish, and growing plants be removed from the structure. Mattresses (except waterbeds) and pillows that are

completely enveloped in waterproof cover must be removed. Food (including those items in refrigerators and freezers) and medicines not adequately sealed must be removed from fumigation sites or double bagged in Nylofume bags. The label and manual for Vikane® give additional instructions on preparations for taurpaulin and taped fumigations.

The Vikane® product label requires that chloropicrin be used as a warning agent and be released into the structure at least five to ten minutes prior to introduction of the fumigant. Vikane® is released into large open spaces in the fumigation site via a leak-proof tube with a minimum burst pressure of 500 pounds per square inch (psi). The fumigant should be directed into the blast of a fan with a minimum capacity of 1,000 cubic feet per minute for each pound of Vikane® released per minute. The label gives two options for aeration procedures based on the rate used. Structures may be reoccupied when concentrations of Vikane® are 5 ppm or less. Only an approved detection device, such as the INTERSCAN or MIRAN, may be used to confirm concentrations. Vikane® is a restricted use pesticide due to its inhalation toxicity and includes the Signal Word “Danger” on the label.

Chloropicrin

As of December 2001, forty-seven products containing chloropicrin were registered for use in California. Ten of those are registered for use in structural fumigations. Chloropicrin is primarily used as a preplant soil fungicide to control root-attacking pathogens, nematodes, insects and weed seeds. It is also used to treat wood poles and timber for internal decay and space, and for vault fumigations to control mites, cockroaches, silverfish, and fungi. Chloropicrin is used as a warning agent for odorless structural and soil fumigants.

The product labels for Metapicrin® and Chlor-O-Pic (both with 99% active ingredient) give detailed instructions for using chloropicrin in space fumigations (not containing raw agricultural commodities). Prior to application all windows, door, and other openings should be sealed to make the structure gas tight. Temperatures at time of fumigations are to be at least 60 °F for Chlor-O-Pic® and 80 °F or higher for Metapicrin® and winds should be relatively calm. Use rates vary from 0.35 to 1 pound per 1000 cubic feet. The product is introduced into a shallow pan, onto burlap sacks, or other absorbent material. Fans should be used to hasten evaporation and to keep fumigant in circulation. Area should be ventilated for 12 to 24 hours or until the air concentration level is measured to be less than 0.1 ppm.

According to the label for Chlor-O-Pic®, chloropicrin can be used as a warning agent and is applied to structures five to ten minutes prior to fumigation with methyl bromide or sulfuryl fluoride. When used in this manner, the chloropicrin at use rate of one ounce per 10,000 cubic feet of space to be fumigated is dispersed into a shallow plastic or non-aluminum metal pan with a “wicking agent” (usually cotton). The container is placed in the direct air stream of a fan to hasten evaporation. Additional fans may be used to distribute the chloropicrin throughout the structure. Chloropicrin is a restricted use pesticide due to its acute toxicity and includes the Signal Word “Danger” on the label.

Pesticide Use Summary

With DPR's implementation of full pesticide use reporting in 1990, all users must report the agricultural use of any pesticide to their county agricultural commissioner, who subsequently forwards this information to DPR. DPR compiles and publishes the use information in the annual Pesticide Use Report (PUR). DPR data for structural fumigations include pesticide applications used for structural pest control, public health pest control, vertebrate pest control, regulatory pest control, and other non-cropland fumigations not included in the above categories. The information included in this monitoring recommendation reflects applications of sulfuryl fluoride and chloropicrin in the DPR's broad structural fumigations.

According to the PUR, the annual use for structural fumigations in California from 1997 to 2000 ranged approximately 1,800,000 to 2,700,000 pounds of sulfuryl fluoride (Table 3) and 1,700 to 5,400 pounds of chloropicrin (Table 5). The majority use of sulfuryl fluoride occurred in three counties - Los Angeles, Orange, and San Diego. The majority of structural use of chloropicrin occurred in four counties - Los Angeles, San Diego, Sacramento, and Fresno. On average, the use of the top 15 counties accounted for 97 and 93% of the total structural use in California for sulfuryl fluoride and chloropicrin, respectively. Tables 4 and 6 display monthly use for structural fumigations in each county for the years 1997 - 2000.

Table 3 Annual Sulfuryl Fluoride Use for Structural Fumigation by County
(Pounds Active Ingredient)

COUNTY	1997	1998	1999	2000	TOTAL
LOS ANGELES	759,847.8	695,468.4	921,227.5	806,172.2	3,182,716.0
ORANGE	330,548.4	412,220.5	466,664.2	401,696.3	1,611,129.4
SAN DIEGO	254,249.0	354,054.1	385,589.3	369,391.2	1,363,283.6
SANTA CLARA	142,870.7	164,279.0	345,199.0	163,346.1	815,694.8
VENTURA	93,371.6	79,161.2	106,680.6	112,202.1	391,415.5
SANTA BARBARA	47,409.1	67,817.1	75,176.2	101,492.3	291,894.7
SAN BERNARDINO	50,981.7	63,849.2	65,622.9	71,249.0	251,702.7
RIVERSIDE	36,166.0	56,092.8	59,352.1	65,822.5	217,433.5
KERN	32,310.5	43,829.0	38,831.3	34,386.2	149,356.9
MONTEREY	31,122.3	34,448.3	36,951.5	41,112.3	143,634.4
SAN LUIS OBISPO	22,478.0	34,074.8	41,241.4	40,653.0	138,447.1
SAN MATEO	24,997.3	31,060.5	33,488.9	36,804.3	126,351.1
ALAMEDA	8,396.6	9,986.8	70,500.9	15,585.6	104,469.8
SANTA CRUZ	21,048.0	27,741.7	31,902.2	22,769.3	103,461.2
FRESNO	19,946.3	23,715.0	28,809.5	25,733.1	98,203.8
Total for Top 15 Counties	1,875,743.3	2,097,798.4	2,707,237.5	2,308,415.5	8,989,194.5
Percent of CA Total	97	97	97	96	97
Total Statewide Use	1,935,677.0	2,170,745.5	2,777,722.9	2,406,133.0	9,290,278.4

Table 4 Monthly Sulfuryl Fluoride Use for Structural Fumigation by County for years 1997-2000

(Pounds Active Ingredient)

COUNTY	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
ALAMEDA	5,589	5,183	7,956	9,870	11,367	7,724	9,840	8,182	8,189	12,608	9,719	7,234
AMADOR	23		39	39			37		38			
BUTTE		35	18	20	22	45	60	23	131	137	26	15
CALAVERAS			27				25			105		111
COLUSA				35					129		14	
CONTRA COSTA	944	984	1,276	1,635	1,468	1,471	1,824	2,740	1,868	2,054	1,811	988
DEL NORTE												
EL DORADO				68	63	31	9	10				
FRESNO	6,904	6,702	10,010	8,270	9,760	10,700	6,591	6,765	10,263	8,763	6,662	6,813
GLENN				28	24							
HUMBOLDT				40	15			169		25		59
IMPERIAL	45				76			3	30			22
INYO		87	52	40	70	17	65	104		157	139	64
KERN	11,638	10,713	15,772	14,138	14,470	14,394	11,325	10,865		10,504	11,930	12,793
KINGS	1,574	1,156	2,169	1,686	1,245	3,204	1,488	1,165		1,287	1,310	2,208
LAKE					26		2	51		145	180	
LASSEN					3							
LOS ANGELES	229,602	199,256	228,986	301,909	293,612	281,264	300,399	305,234		288,970	268,046	235,183
MADERA	56	198	219	120	165	327	1,063	304		408	261	174
MARIN	1,102	1,079	868	1,403	1,370	1,525	1,276	1,546		1,952	1,582	895
MARIPOSA					23		39	50		20		
MENDOCINO	504	195	309	321	164	290	516	169		1,263	1,106	506
MERCED	532	1,219	501	678	672	1,005	714	688		767	500	694
MONTEREY	9,318	8,097	10,372	11,474	13,784	14,229	13,052	11,661		14,381	14,383	10,281
NAPA		40	115	237	174	246	153	94		128	313	181
NEVADA						84		20		140		
ORANGE	97,753	100,330	160,273	144,486	144,844	139,887	140,215	150,118		150,044	148,542	102,576
PLACER	64	85	39	42	207	197	150	21		102	726	192
PLUMAS			15		1	43		42				
RIVERSIDE	12,380	13,619	15,184	17,927	18,434	19,831	26,107	20,606		19,930	17,352	17,633
SACRAMENTO	1,502	1,518	1,762	1,659	1,688	2,252	2,058	1,954		2,526	2,185	3,107
SAN BENITO	746	618	891	785	1,021	1,566	720	1,134		1,057	739	719
SAN BERNARDINO	16,660	18,183	18,816	24,448	22,523	25,183	21,940	22,973		23,000	22,131	16,419
SAN DIEGO	96,083	84,082	115,379	107,667	113,240	163,584	99,641	122,736		128,777	105,796	102,808
SAN FRANCISCO		381			1,019	927	61	13		21		244
SAN JOAQUIN	733	726	1,424	1,212	1,404	1,491	1,382	1,393		1,304	4,868	1,563
SAN LUIS OBISPO	6,527	8,322	10,677	12,596	11,459	13,559	11,637	13,769		12,608	11,891	11,573
SAN MATEO	8,369	6,577	8,726	10,537	8,944	11,491	11,703	13,076		14,386	12,316	9,092
SANTA BARBARA	19,414	17,373	22,502	25,295	25,339	30,228	23,643	42,951		22,926	19,830	17,321
SANTA CLARA	44,323	38,523	53,140	53,986	56,655	64,664	61,661	75,016		49,813	57,419	43,936
SANTA CRUZ	4,493	4,180	5,645	8,500	8,030	11,490	8,465	10,400		9,422	10,500	8,390
SHASTA	18	51	36	30	108	68		57		63		
SIERRA												
SISKIYOU		46		24	19	28		28				
SOLANO	389	231	363	425	407	766	508	455		318	268	227
SONOMA	3,721	2,618	3,322	63,291	3,308	4,146	3,170	4,081		5,277	4,384	2,904
STANISLAUS	770	991	1,091	1,343	1,077	1,109	610	758		1,725	1,402	938
SUTTER			108		76	83	13	12		19	21	

TEHAMA	22	24	50	43	25	102	15	47	78	100		
TRINITY				30		32						
TULARE	3,000	3,419	3,823	4,799	4,267	2,868	3,008	3,221	4,321	5,445	3,787	
TUOLUMNE							16	13			0	
VENTURA	22,188	27,724	34,779	31,073	33,278	50,192	27,600	36,088	37,698	31,680	24,772	
YOLO	121	266	87	143	413	160	322	194	257	161	64	
YUBA				44	48	99		24		36		
ALAMEDA	5,589	5,183	7,956	9,870	11,367	7,724	9,840	8,182	8,189	12,608	9,719	7,234



Table 5 Annual Chloropicrin Use for Structural Fumigation by County
(Pounds Active Ingredient)

COUNTY	1997	1998	1999	2000	TOTAL
SAN DIEGO	2,308.7	1,172.3	1,275.2	897.7	5,653.9
LOS ANGELES	1,600.2	1,491.6	1,636.2	156.8	4,884.9
SACRAMENTO	13.2	584.1	2,236.2	10.5	2,844.0
FRESNO	148.6	177.8	1,857.1	83.0	2,266.7
KERN	522.7	51.7	65.3	85.0	724.7
SAN JOAQUIN	16.9	362.6	289.5	0	669.0
SONOMA	527.9	124.7	1.7	0	654.4
MONTEREY	76.2	253.0	106.4	129.8	565.4
SANTA CRUZ	142.5	270.9	30.7	104.3	548.4
ORANGE	52.4	347.9	64.0	58.3	522.6
VENTURA	89.8	219.5	146.5	64.6	520.5
SAN BERNARDINO	39.8	92.8	66.2	97.9	296.7
SANTA CLARA	19.9	256.1	11.8	8.7	296.4
RIVERSIDE	34.7	143.6	45.8	52.5	276.7
SOLANO	5.4	106.2	148.9	2.5	263.0
Total for Top 15 Counties	5,598.9	5,654.8	7,981.5	1,751.6	20,987.3
Percent of CA Total	96	91	94	91	93
Total Statewide Use	5,854.1	6,224.1	8,523.9	1,931.5	22,533.6

Table 6 Monthly Chloropicrin Use for Structural Fumigation by County for Years 1997-2000

(Pounds Active Ingredient)

COUNTY	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
ALAMEDA		0.01									2.49	0.84
AMADOR	35.04			0.21			0.21			94.17	39.99	28.38
BUTTE		0.37	0.21	0.27	30.10	0.27	0.63	0.21	0.16	0.31	0.31	0.10
CALAVERAS			0.16				0.21			0.36		
COLUSA				0.31	2.97		34.40				0.10	
CONTRA COSTA	0.75	0.45	0.57	0.53	0.72		3.42	1.79		1.01	0.91	0.27
DEL NORTE				0.75								
EL DORADO	59.34			0.74	77.64	0.32	0.41					
FRESNO	30.25	24.92	48.11	41.91	43.98	1,798.23	39.98	45.90	75.79	58.83	32.86	25.90
GLENN					0.21							
HUMBOLDT								0.32		0.16		0.32
IMPERIAL	0.47				0.88			0.78	0.31			0.21
INYO									0.24			
KERN	16.64	17.67	27.55	22.75	22.25	24.22	23.70	29.28	21.32	17.59	482.44	19.32
KINGS	13.41	6.44	16.25	15.34	27.64	19.68	18.09	11.72	16.97	17.36	7.47	11.13
LAKE				0.04		0.01	0.60		0.88	1.08	0.42	0.17
LASSEN												
LOS ANGELES	428.86	193.87	407.01	287.20	250.39	465.16	565.58	304.43	1,158.05	411.62	254.52	158.21
MADERA	0.16	0.02	0.74	0.21	1.41	0.27	0.09	1.73	3.56	1.06	2.09	0.31
MARIN	0.71	0.88	2.42	1.59	3.95	7.39	5.33	4.52	2.15	2.92	2.22	41.78
MARIPOSA							0.31	0.31	0.56	0.41		
MENDOCINO	0.32	0.11	0.06	0.43	0.39	1.24		88.59	1.84	0.62	1.27	1.34
MERCED	2.72	3.06	8.12	2.57	3.01	9.44	1.51	1.48	2.49	2.61	1.49	4.52
MONTEREY	24.45	19.60	28.87	24.56	86.28	46.13	29.64	66.13	78.53	101.49	34.42	25.30
NAPA	18.06		0.47	0.97	0.32	0.51	1.07	0.60	0.76		0.53	33.75
NEVADA			38.70			1.39	23.22				0.15	
ORANGE	31.10	42.48	42.36	48.02	55.51	47.23	49.87	43.65	40.73	41.96	40.87	38.81
PLACER	0.31	0.16	0.50	53.32	38.17		1.17		0.75	0.90	0.88	0.21
PLUMAS												
RIVERSIDE	20.04	18.25	27.42	19.90	26.85	23.22	30.66	21.73	26.84	25.88	19.45	16.42
SACRAMENTO	417.98	517.16	133.73	214.24	533.21	269.88	165.62	7.69	5.85	228.82	171.45	178.35
SAN BENITO	1.52	0.47	2.69	2.06	2.19	5.69	3.15	4.44	0.63	2.95	2.67	1.11
SAN BERNARDINO	13.88	24.70	21.10	29.56	27.27	26.86	30.57	29.01	23.12	26.45	22.57	21.58
SAN DIEGO	239.85	333.78	267.09	1,685.25	408.10	438.55	384.94	455.23	448.47	435.99	287.73	268.97
SAN FRANCISCO						1.82	0.04	0.04			0.05	
SAN JOAQUIN	18.56	2.82	93.34	72.59	4.00	4.88	101.75	3.47	4.66	236.68	81.84	44.36
SAN LUIS OBISPO	2.58	1.94	8.07	7.80	4.83	8.44	7.15	11.08	18.58	7.72	6.28	4.43
SAN MATEO	2.39	1.13	0.37	1.15	2.52	2.50	1.79	3.97	1.52	4.23	1.38	1.96
SANTA BARBARA	5.53	2.55	2.96	0.33	5.24	1.24	6.57	5.63	12.27	10.87	7.08	8.49
SANTA CLARA	6.98	105.03	4.13	5.44	62.87	72.31	9.61	6.05	16.97	2.17	1.71	3.18
SANTA CRUZ	19.17	12.76	19.95	25.84	67.46	172.31	79.93	45.72	20.24	25.16	35.88	24.03
SHASTA						0.31			0.37			
SIERRA									0.31			
SISKIYOU				0.21		0.32			0.42			
SOLANO	0.21	19.80	7.31	107.20	8.66	1.75	4.00	2.85	8.52	37.76	62.98	1.98
SONOMA	2.87	1.30	3.54	4.53	2.27	5.00	5.29	524.03	4.65	6.97	88.51	5.42
STANISLAUS	2.60	2.23	2.68	3.51	3.31	2.05	2.82	3.51	4.06	12.77	3.72	3.49
SUTTER			1.07			4.31			0.63	0.21		
TEHAMA			0.21	0.53		0.16	0.42	0.16	0.53		0.16	0.43
TRINITY												

TULARE	6.88	5.50	6.18	8.73	14.71	8.34	10.83	16.09	9.81	10.66	8.11	5.10
TUOLUMNE									0.42	60.63		
VENTURA	22.63	27.88	52.23	49.00	27.57	81.26	53.99	46.47	43.14	45.18	35.46	35.68
YOLO	0.73	2.35	0.21	0.63	1.69	1.21	0.63	1.10	0.47	1.73	0.47	0.05
YUBA				0.52	0.63	0.42		0.31			33.54	
ALAMEDA		0.01									2.49	0.84

C. APPLICATION SITE AIR MONITORING RECOMMENDATIONS

The historical trends for sulfuryl fluoride and chloropicrin applications indicate that the highest use areas are where the largest populations reside, Los Angeles and Orange Counties for sulfuryl fluoride and Los Angeles and San Diego Counties for chloropicrin, although almost all counties have some applications during the years of 1997-2000. Tables 4 and 6 indicate that structural application uses of both sulfuryl fluoride and chloropicrin occur throughout the year. The sulfuryl fluoride label allows aeration through open windows and doors with the use of interior fans for at least 1 hour, and aeration completion by different times depending on application rate. The chloropicrin label states that aeration should be done by opening doors and windows with the use of interior fans for 12 to 24 hours until the air concentrations are below 0.1 ppm. DPR does not specify a preference of aeration method for the monitoring study.

Since chloropicrin is always used as a warning agent for sulfuryl fluoride application to structural fumigation, DPR recommends one monitoring study for both sulfuryl fluoride and chloropicrin simultaneously. A target 24-hour quantitation limit of 30 $\mu\text{g}/\text{m}^3$ is recommended for sulfuryl fluoride and 0.1 $\mu\text{g}/\text{m}^3$ for chloropicrin. The application dosage of sulfuryl fluoride can vary, for a typical single-family house fumigation, from 6 – 16 ounces per 1,000 cubic feet for termites to a higher application rate necessary to control Powderpost beetle. DPR recommends selecting a site with a volume of at least 26,000 ft^3 , a crawl space without a barrier, and an exposure time of at least 36 hours that will be treated for the Powderpost beetle to assure a higher application rate.

DPR recommends close coordination with the county agricultural commissioner to select the most appropriate sampling sites. Permission from property owner must be obtained before the monitoring start. The structure selected for monitoring must have enough clearance surrounding it to allow for sampler placement at a distance of 5 and 10 feet from the edge of the structure. Four background samples should be taken prior to application. Twelve samplers should be placed surrounding the structure as three rings. The first ring consists of four samplers located at the middle of and 5 feet from each side of the structure. The second ring consists of four samplers 10 feet out from each corner of the structure. The third ring contains four samplers which would be placed 30 to 80 feet from each side or corner of the structure. A thirteenth sampler will be collocated with one sampler in the first ring and at the site that is expected to be downwind during aeration. The collocated sample will be collected at this site during each sampling interval. Sample intake should be 1.5 to 2.0 meters above ground.

For both sulfuryl fluoride and chloropicrin, samples should be taken before application, during application, during mechanical and tarp removal aeration (alternate Daytime/ Overnight sampling according to the duration of aeration), and post aeration for two Daytime/Overnight sampling

periods. Additionally, after completion of aeration, two 24-hour samples should be taken at each of two different locations inside the fumigated structure for 48 hours sampling duration (total of four samples inside structure). To minimize exposure to sampling personnel, DPR recommends selecting structure that would fumigate for 24 hours and follow the revised sampling schedule:

Sample period begins:	Sample duration time
Background (pre-application)	Minimum 12 hours and long enough to meet the recommended ambient quantitation limits
During application	Daytime (until 1 hour before sunset)
During application	Overnight (until 1 hour after sunrise)
Beginning of Aeration	Until cleared (Daytime/ Overnight)
End of Aeration	Until 1 hour before sunset/ 1 hour after sunrise
1 hour before sunset/ 1 hour after sunrise	Overnight ¹ / Daytime
1 hour after sunrise/ 1 hour before sunset	Daytime/ Overnight
<i>in addition:</i> after aeration is complete	24-hour sample inside structure
24-hour post aeration	24-hour sample inside structure

¹ All over night samples must include the period from one hour before sunset to one hour after sunrise.

For quality assurance, trip spikes should be prepared in the lab and maintained under the same conditions with the samples. Field spikes will be run in the field with samples.

DPR requests the following information be included in the monitoring report:

- 1) an accurate record of the positions of the monitoring equipment with respect to the structure, including the exact direction and distance of the samplers from the edge of the structure and a record of three dimensions of the structural;
- 2) an accurate record of pesticide application, including application time, method, dosage (rate), fumigation duration, aeration method and duration, etc.
- 3) an accurate drawing of the monitoring site showing the precise location of the meteorological equipment, trees, other buildings, and other obstacles with respect to North (identified as either true or magnetic North);
- 4) if applicable, meteorological data collected at 1-minute intervals including wind speed and direction, humidity, air temperature, and comments regarding degree of cloud cover.

D. SAFETY RECOMMENDATIONS

Most of the following safety precautions pertain to applicators. In this recommendation, the sampling schedule is arranged to prevent sampling personnel from being near the structure during application. Therefore, most of these precautions are for reference only.

Product labels for the fumigants carry a danger warning. Inhalation of the vapors may be fatal or cause acute illness or delayed lung or nervous system injury if exposed to high concentrations. Do not get in eyes, on skin, or on clothing. Chloropicrin is also a strong lachrymator causing painful irritation to the nose and throat and causing tearing of the eyes. The labels recommend application personnel wear loose-fitting or well-ventilated long-sleeve shirt and long pants, and socks and shoes; chloropicrin also requires a full-face shield or safety glasses with brow and temple shields.

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